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EXHAUST-SYSTEM SUPPORT FOR FIXING THE EXHAUST SYSTEM OF A MOTOR VEHICLE

The present invention lies in the field of automotive engineering and concerns according to its type a motor vehicle driven by a combustion engine and comprising an exhaust system bracket for fastening the exhaust system.

Up to now, exhaust systems in motor vehicles are predominantly fastened to the vehicular floor pan by means of rubber suspensions. A disadvantage with this type of fastening is that the rubber suspension in general will not offer a sufficient damping, so that it may happen that vibrations emanating from the unit of motor and gearbox, as well as natural oscillations of the exhaust system are conducted to the vehicular floor pan. Through this, vibrations and humming noises may occur in the vehicle interior space which are regarded by the driver and passengers as a great nuisance.

In order to avoid these impairments, it was considered to additionally affix the exhaust system to the motor housing and gearbox housing, respectively. The purpose of this arrangement is to reduce the vibrations of the exhaust system by damping, using such a bracket which is fixed to the motor or gearbox.

The present invention is based on the object to provide an exhaust system bracket which allows an efficient damping, further is practicable at low costs and has a low weight.

According to the invention, this object is met by the features of claim 1. Advantageous embodiments of the invention are set forth in the sub-claims.

According to the invention, a bracket for the exhaust system which fulfills the above requirements is characterized in that the exhaust system is fastened to the motor and/or the gearbox through the exhaust system bracket which comprises a

supporting element in the form of a plate holder with at least two band-like, elastic plates which are superimposed so as to form a stack and are able to move relative to each other on at least a part of their length. A "plate" in the sense of the present invention is meant to be a flat shape with a length which is considerably larger than its width, while its thickness is considerably smaller than its width.

If there occurs a vibration-induced deflection in the stacking direction of the plates, there will be achieved - by the superimposed plates - a damping of the vibration on account of the friction between the surfaces of the plates which are moved relative to each other upon such deflection. In this way the vibrations of the exhaust system will be reduced. Owing to its construction, a supporting element of this type can be hard enough, on the one hand, to achieve a sufficient damping of vibrations, and on the other hand can have sufficient pliancy in order to fulfill the thermomechanical requirements in terms of strength.

Compared to a bracket in solid construction and with the same overall height, it is only a bracket with the plate construction according to the invention which is able to take up the thermal elongations of the exhaust system relative to the connected structure. A solid bracket has a higher rigidity in relation to a plate holder according to the invention and hinders the thermal elongation of the exhaust system. That's why high stresses arise on the solid bracket, which in the end may result in a rupture of the bracket due to the constant thermal shock stress.

By increasing the number of the plates in the supporting element it is possible to advantageously increase the number of the surfaces which rub against each other during any deflection. Increasing the number of adjoining surfaces rubbing against each other during displacing will result in an enhancement of the damping effect, while diminishing such number will result in a reduction in the damping effect. Same applies to an enlargement of the mutually contacting surfaces of the plates. According to the invention, at least two plates are stacked in the supporting element. It is preferred that three to five plates are provided.

The damping behavior of the supporting element can be advantageously influenced by the surface condition of the plates rubbing against each other during deflection. A smooth surface of the friction surfaces results in a correspondingly low vibration damping effect because of the comparably low friction, while a rough surface will enhance the vibration damping effect. Further it may be favorable to provide a structure on the friction surfaces, for instance linear raised portions which enhance friction. With a given geometry of the plates in a supporting element, the frictional effect of mutually abutting plate surfaces can thus be modified in the desired way.

By altering the geometry of the plates in the supporting element the rigidity thereof can be modified in an advantageous way. Enlarging the plate thickness results in an enhanced rigidity with an otherwise unchanged geometry of the plates, and vice versa. It is likewise possible to induce an enhancement of the rigidity by reducing the length of the plates with an otherwise unchanged geometry of the plates, and vice versa. Same applies to the overall thickness (height) of the supporting element formed by the plates, and to the length of the supporting element.

One can also have influence on the rigidity and the damping behavior of the supporting element by the design of the profile of the individual plate. This can be effected, for instance, by means of U-profiles or T-profiles or stiffening corrugations. The profile can be provided continuously or in sections.

An alteration of the length of the supporting element further has influence on its endurance life with regard to the thermal stresses from the exhaust system. Concerning the thermal elongations, these will show varying effects when the height of the supporting element is altered. In this respect, the height and length of the supporting element are to be suitably selected in the light of these aspects.

It is possible by virtue of the supporting element, according to the invention, for fastening the exhaust system to the motor and/or gearbox that the damping behavior can be influenced at advantage in various directions in a suitable way.

Such a reliance of the damping effect on the direction can be achieved with a preferred embodiment of the invention additionally by means of a suitable structural shape of the supporting element. For this purpose, the supporting element thus may have an angular structure as seen in the longitudinal section. Here it is particularly preferred that the angular structure is a twofold angular structure in the form of an offset step. "Offset step" in the sense of the present invention means a structure in which, as seen in the longitudinal section, one end of the structure is not situated in the prolongation of a tangent to the other end of the structure.

In a further preferred embodiment for influencing the reliance of the damping effect on the direction, the supporting element, as seen in the longitudinal section, has a fourfold angular structure in the form of two offset steps which are arranged mirror-inverted to each other. A structure of this type is, in particular, designated for not providing an offset, i.e. as seen in the longitudinal direction one end of the structure lies in the prolongation of the tangent to the other end of the structure.

The supporting element may also have a helical structure. Hereby the rigidity against a twisting of the supporting element (rotational force) can be considerably enhanced.

With the supporting element according to the invention, the plates may consist of an austenitic or ferritic material. Non-ferrous, metallic materials (e.g. carbon fibers, plastics, aluminum etc.) which meet the demands on the mechanical and thermomechanical durability, may also be employed. It is likewise possible that the plates are made of spring steel. Given the geometry of the plates or of the supporting element, the selection of a suitable material depends in particular on the rigidity, the damping effect and the thermal resistance. For this purpose, the plates in particular may be made of the same material or of different materials. The plates can also have differing thicknesses.

A mutual fastening of the plates in such a manner that they can be moved relative to each other at least on a part of their length, is preferably established by

screwing, welding or a form-fitting and/or force-fitting connection. In the latter case there is preferred a particularly simple embodiment in which one exterior plate in the plate stack is flanged so as to clamp the plates of the supporting element on at least one front end and/or longitudinal side. Thereby it is possible to achieve an asymmetric characteristic in terms of rigidity.

The supporting element according to the invention can be directly fastened to the exhaust system and/or to the motor- or gearbox housing by means of welding, for example. It would also be possible that the supporting element according to the invention is fastened to the exhaust system by means of a console. The supporting element according to the invention can be fastened to the motor or gearbox by a bracket which is provided on the motor- or gearbox side. In the latter case, fastening the supporting element to the console or above bracket, provided on the motor- or gearbox side, can be done by screwing.

In summary it can be ascertained that the supporting element according to the invention allows the damping characteristics to be engineered in an advantageous manner such that they are different in different directions in space. There may occur a damping across the range of frequencies to be damped, with the possibility to have influence on the damping factor in particular by the number of plates, the thereby involved friction surface of the plate surfaces which rub against each other when the supporting element is deflected, and the condition of these surfaces. The rigidity can be influenced in particular by the material selection, the number of plates and their geometry. In this respect, an adaptation of the specific design to the needs of the user in terms of damping and rigidity would also be possible. The thermomechanical endurance life of the supporting element is ensured by the pliant plate structure.

Compared with conventional suspensions systems for exhaust systems, the system of the invention for fastening the exhaust system is reasonably priced, as there is no need for elastomer elements which are susceptible to aging and have to be shielded, if necessary, nor is it required to provide additional damping systems like vibration neutralizers or decoupling elements.

Moreover, the arrangement is compact, so that a small installation space will be sufficient for fastening the exhaust system to the motor and gearbox, respectively. The exhaust system bracket can simply be exchanged when a repair is required. A connection to existing systems is easily possible. It is of advantage that the gas-carrying system will not be impaired, which otherwise - e.g. in case decoupling elements are employed - could cause problems with respect to leak tightness, thermal insulation and endurance life.

This is why additional supporting elements for ensuring the mechanical endurance life are required when decoupling elements are used. In the ideal case the plate holder according to the invention is able to replace the decoupling element and correspondingly save costs.

Also where economy of weight is concerned, the supporting element according to the invention is superior to conventional brackets with vibration neutralizers: assuming that a conventional vibration neutralizer has a mass of approximately 1 kg, a comparable supporting element according to the invention weighs only approximately 250 g, including the console on the side of the exhaust system.

The invention will now be explained in more detail with the aid of embodiments with reference being made to the attached drawings.

Figure 1 is an overview illustration of the bracket, according to the invention, of the exhaust system;

Figure 2 shows a longitudinal section (upper part) and a top view of a first embodiment of the supporting element according to the invention;

Figure 3 shows a second embodiment of the supporting element according to the invention, for illustrating an angular structural shape;

Figure 4 shows a third embodiment of the supporting element according to the invention, with plates being clamped by one flanged plate,

Figure 5 shows a top view of the supporting element according to the invention, for a schematic illustration of connection points (upper part), as well as a longitudinal section taken through a possible embodiment of the supporting element according to the invention (lower part), and

Figure 6 illustrates an exemplary installation situation of supporting elements according to Fig. 1 to 5.

At first Fig. 1 is to be seen, showing an overview illustration of the bracket configured according to the invention and provided for the exhaust system.

A combustion engine has an exhaust system 2 which is supplied via an exhaust manifold adapted 4 of an upstream pipe 3 from an exhaust manifold (not illustrated) with combustion gases, the exhaust system being fastened to the gearbox housing 5 by means of the supporting element 1 according to the invention in the form of a plate holder. The gearbox housing 5 is connected with the engine block through the engine block attachment 6. On the side of the exhaust system, the supporting element 1 is fastened to the exhaust system by means of a console 8, namely to the inlet funnel of the catalytic converter. Supporting element 1 and console 8 are connected by welding. On the side of the gearbox the supporting element 1 according to the invention is fastened to the gearbox housing 5 by a bracket 7. Fastening the supporting element 1 to the bracket 7 is effected by a screwed connection 9. The supporting element 1 consists of three band-like, elastic plates which lie one on top of the other. As seen in the longitudinal section, the supporting element 1 has a twofold angular structure in the form of an offset step.

Fig. 2 illustrates in detail another embodiment of the supporting element 1 in the form of a plate holder. As can be taken from the upper picture of Fig. 2, a longitudinal section, the supporting element 1 is composed of three individual plates 10, 11 and 12. A single plate has the thickness d, with the height h of the supporting element 1 resulting from the thicknesses of the three individual plates.

The lower picture in Fig. 2 shows a top view of the supporting element 1 which has been assembled from stacked individual plates 10, 11, 12. The supporting element has a length l and a width b. Reference numeral 13 shows a point near one longitudinal end of the supporting element where the latter is connected to the motor- or gearbox housing, while reference numeral 14 shows a point near the other longitudinal end of the supporting element where the latter is connected to the exhaust system.

Fig. 3 shows a further advantageous embodiment of the supporting element according to the invention, for illustrating an angular structural shape of supporting element 1. In this embodiment and as seen in the longitudinal section, the supporting element 1 composed of two plates 15, 16 has a fourfold angular structure in the form of two offset steps which are arranged mirror-inverted to each other. The structure is angled at the corners 17, 18, 19 and 20. The ends of the supporting element show no offset, i.e. both ends of the structure are in the same plane.

Fig. 4 shows a further advantageous embodiment of the supporting element 1 according to the invention, in which the individual plates 21, 22, 23 are fastened to each other by a flanged connection. In this arrangement, the plates 21, 22 are clamped at their front ends and, if appropriate, at their longitudinal sides by plate 23 which is the exterior plate in the stack of supporting elements 1.

Fig. 5 (upper picture) shows a top view of the supporting element according to the invention, for a schematic and only exemplary illustration of fastening points for a mutual fastening of the plates. Thus, it is possible for instance to join the plates at three fastening points on each of the two longitudinal sides. It is likewise possible to join the plates at two fastening points on each of the two longitudinal sides. It would likewise be possible to join the plates at only one fastening point on each of the two longitudinal sides, with this fastening point preferably being provided in the middle. At the front end of the plates, these could be fastened to each other by one single fastening point, for instance at the middle or at the right-

hand or left-hand side. It is also possible that the plates are fastened to each other at their front ends by two fastening points in each case.

Fig. 5, lower picture, shows an embodiment of the supporting element according to the invention in the longitudinal section, in which the plates have been fastened to each other on the longitudinal side by two fastening points at each end. Any form-fitting and force-fitting connections are permissible (e.g. spot welding, welding, riveting, screwing, brazing, gluing, magnet).

Fig. 6 shows the installation situation of a supporting element 1, having the design explained above, in a schematically illustrated motor vehicle K. Apart from the design of the bracket for the exhaust system 2, this vehicle is constructed in a manner known per se and has a front motor M with an associated radiator WK and a gearbox G. The exhaust system 2 includes, for example, an exhaust manifold AK, an upstream pipe 3, a catalytic converter Ka, a middle exhaust silencer MS and an end exhaust silencer ES with a tail pipe; the catalytic converter Ka being connected with the middle exhaust silencer MS and the latter being connected with the end exhaust silencer ES through exhaust pipes AR. In this respect, the motor vehicle K according to Fig. 6 corresponds to the well known prior art, so that no further explanation will be needed.

Among others, a supporting element 1 with the construction explained above serves for supporting the exhaust system 2, by means of which supporting element the catalytic converter Ka is resiliently fastened to the gearbox housing 5.